ABSTRACT

The Alternative Current (AC) induction, asynchronous motor, and the Permanent Magnet (PM) synchronous, or the Brushless Direct Current (BLDC) motor, which are types of the Permanent Magnet (PM) synchronous machines, can be applied in hybrid power trains. This chapter presents the fundamental theory as a necessary background to the mentioned motors’ generic dynamic nonlinear model determination. The differential equations based on the phase quantities as a complete system of equations describing the transients should include the equations of winding voltages and the equations of motion for the rotating parts of the machine. The phase quantities in terms of the resultant phasors as the background to dynamic modeling are taken into consideration. Introducing a complex (α, β)-plane stationary relative to the stator of a two-pole model equations set is carried out including transformation from the α- and β-axis components of the stator quantities to the d- and q-axis components of rotor quantities. This chapter is a source of the advanced knowledge concerning the principles of electric machine modeling. It might be useful for mechanical engineers engaged in the hybrid vehicle power train design process, but also for electrical engineers, especially those attending master and doctoral courses.
INTRODUCTION

The asynchronous, induction (AC) motors and permanent magnet, synchronous (PM) or permanent magnet, brushless, direct current (BLDC) motors, which are, in fact, a kind of PM synchronous machines, are considered. The fundamental theory necessary for the above-mentioned electric machines’ mathematical dynamic modeling in this chapter is presented.

1. AC ASYNCHRONOUS INDUCTION MOTOR MODELING

Transient phenomena may be initiated by a balanced or an imbalanced change in the time phase or peak value of the Alternative Current (AC) and voltages U, fed to the stator winding (e.g. by a change in the peak values of symmetric positive-, negative-phase sequence voltage components, \(U_{11}\) or \(U_{21}\), respectively). A transient phenomenon may be initiated by a sudden change in an external torque, leading to an imbalance of electromagnetic torque, a resultant acceleration, and finally, a new speed value.

1.1. Differential Equations Based on Phase Quantities

The complete system of equations describing transients should include differential equations of winding voltages and equations of motion for the rotating parts of the machine. The 2p-pole, three-phase balanced stator and rotor windings are considered (see Figure 1).

*Figure 1. The scheme of an asynchronous machine*
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